Impact of Tropical Cyclones and Storm Surges on Agriculture in India

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Topics

- India- some salient features
- Tropical Cyclones in Indian Region
- Storm Surges and their Prediction
- Case studies of impact of TCs in the coastal regions of India
- Agromet Advisory Service and Economic Impact Assessment
Agriculture: Primary Sector

- Indian agriculture is inefficient and labor intensive.
- Animals are frequently used for power.
- The village is the focus of life for 74 percent of the Indian population with an estimated 580,000 villages.
- Approximately 2/3 of India's huge working population (63 percent) depends directly on the land for its livelihood.
- Substantial progress toward modernization has been made in the Punjab's wheat zone.
- Half of all rural families either owned as little as a half hectare (1.25 acres) or less, or no land at all.
- Land consolidation efforts have had only limited success, except in the states of Punjab, Haryana, and Uttar Pradesh.
Major crop zones:

1. **Wheat.** Dry northwest notably in the Punjab and neighboring areas of the Upper Ganges. Many gains from the Green Revolution through the introduction of high-yielding varieties developed in Mexico.

2. **Rice.** Moist east and a summer monsoon drenched south. More than 1/4 of all of India's farmland lies under rice cultivation, most of it in the states of Assam, West Bengal, Bihar, Orissa, and eastern Uttar Pradesh. This area has more than 100 cm (40 inches) of rainfall. India has the largest acreage of rice among the world's countries. Yields per hectare are still low at below 1,000 kg (900 lbs./acre), however.

3. **Coconut.** Malabar Coast. (Kerala)

4. **Millet.** Southwestern India. A cereal grass, Setaria italica, extensively cultivated in the East and in southern Europe for its small seed or grain, used as food for man and fowls, but in the U.S. grown chiefly for fodder.

5. **Groundnut.** Kathiawar Peninsula.

6. **Cotton.** West-Central India (Deccan Plateau).

7. **Chick Peas.** Northwest.

8. **Plantation.** Northeast.
Livestock:

- India has more livestock than any other country in the world.
  - Cows - 200,000,000
  - water buffalo - 60,000,000
  - Goats and sheep - 60,000,000
  - Horses, donkeys, and elephants - 5,000,000
- Sheep are of major importance in the drier west where the Islamic population is clustered.
- Buffalo is dominant in the Ganges Delta and coastal regions.
- Cattle (particularly the Brahman or Zebu breeds) are found throughout India.
Average TC Movement in Different Basins
Tropical Cyclones in Indian Region

- Only 7% of the world’s total TC production, takes place in Indian Region.
- There are two major TC seasons: Pre-monsoon (April-May) and Post-monsoon (Oct-Dec).
- Bay of Bengal is 3 times more prone to TC as compared to Arabian Sea.
- On an average only **ONE TC** per year attains Hurricane Intensity in the region.
- The region has highest population density and shallowest coastal bathemetry in the world-highest vulnerability to Storm surge
TROPICAL CYCLONE VULNERABILITY
STATES OF INDIA

• West Bengal
• Orissa
• Andhra Pradesh
• Tamilnadu
• Pondicherry
• Kerala
• Lakshadweep
• Karnataka
• Goa
• Maharashtra
• Gujarat
• Andaman & Nicobar Islands
• Diu & Daman
Potential Impact upon Landfall of a Tropical Cyclone

- **Effect of local Tides**
- **Effect of local Coastal Configuration**
- **Low Atmospheric Pressure in the Centre**
- **Storm Surge**
- **Wind**
- **Rain**
- **Flooding**

### Events

- Flooding of Low-Lying Coastal Areas
- Erosion of Beaches
- Damage to onshore & offshore installations
- Damage to Shipping & Fishing Facilities
- Loss of Soil Fertility from Saline Intrusion
- Land Subsidence
- Contamination of Domestic Water Supply
- Destruction of Vegetation, Crops, Livestock
- Urban Bushfire
- Loss of Communication s & Power
- Loss of Human Life: Injuries
- Damage to structures & Continent

### Consequences

- Flooding of Low-Lying Coastal Areas
- Erosion of Beaches
- Damage to onshore & offshore installations
- Damage to Shipping & Fishing Facilities
- Loss of Soil Fertility from Saline Intrusion
- Land Subsidence
- Contamination of Domestic Water Supply
- Destruction of Vegetation, Crops, Livestock
- Urban Bushfire
- Loss of Communication s & Power
- Loss of Human Life: Injuries
- Damage to structures & Continent
A Storm Surge is an abnormal rise of sea level caused by a cyclone moving over a continental shelf.
## DEATHS IN TROPICAL CYCLONES

<table>
<thead>
<tr>
<th>YEAR</th>
<th>COUNTRIES</th>
<th>DEATHS</th>
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<tbody>
<tr>
<td>1970</td>
<td>Bangladesh</td>
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<tr>
<td>1737</td>
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<tr>
<td>1886</td>
<td>China</td>
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<tr>
<td>1966</td>
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<td>1960</td>
<td>Japan</td>
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<td>1972</td>
<td>India</td>
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- 74% events in the Bay of Bengal
- 59% of Bay events in Bangladesh
- 70% Deaths in Bangladesh
## List of Cyclone Disasters with more than 999 Fatalities (1900-2001)

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<thead>
<tr>
<th>Year</th>
<th>Country</th>
<th>Fatalities</th>
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<tr>
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<tr>
<td>1906</td>
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<td>1928</td>
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<tr>
<td>1946</td>
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<td>1959</td>
<td>Japan</td>
<td>4,600</td>
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<td>1963</td>
<td>Haiti</td>
<td>5,100</td>
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<tr>
<td>1970</td>
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<td>1974</td>
<td>Honduras</td>
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<td>India</td>
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<tr>
<td>1979</td>
<td>Caribbean/ USA</td>
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<tr>
<td>1984</td>
<td>Philippines</td>
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<td>1985</td>
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<td>1988</td>
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<td>1989</td>
<td>Thailand</td>
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<td>India</td>
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<tr>
<td>1998</td>
<td>Nicaragua/ Honduras</td>
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<tr>
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<td>Caribbean</td>
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<td>India</td>
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<tr>
<td>2000</td>
<td>Muzambique</td>
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- 34% events in the Bay of Bengal
- 50% of Bay events in Bangladesh
- 91% Deaths in Bangladesh
## Damage due to Cyclones in excess of 1 billion US $ (1976-2001)

<table>
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<th>Year</th>
<th>Country</th>
<th>Total Damage Million US $</th>
<th>Insurance Damage Million US $</th>
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<td>800</td>
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<tr>
<td>1991</td>
<td>USA</td>
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<td>620</td>
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<tr>
<td>1991</td>
<td>Japan</td>
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<td>5,200</td>
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<td>USA</td>
<td>30,000</td>
<td>20,000</td>
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<td>Hawaii</td>
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<td>1999</td>
<td>India</td>
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<tr>
<td>2001</td>
<td>USA</td>
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<td>3,000</td>
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<td></td>
<td>115</td>
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</table>
Case Studies of TC Impact
A case study of Andhra Pradesh
Cyclone of December 2003
Information From DSS include …

- Population to be affected
- Densely populated villages
- Areas under threat
- Threat to Crops
- Damage to Structures
- Rail and Road network in the affected areas
- Vulnerable points
- Cyclone shelters
WIND HAZARD MODEL
DAMAGING WIND SPEEDS FOR CROPS
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003

LEGEND
- Damaging wind speeds for crops:
  - 0 - 5 m/s
  - 5 - 10 m/s
  - 10 - 15 m/s
  - 15 - 20 m/s
  - 20 - 25 m/s
  - 25 - 30 m/s
  - 30 - 35 m/s
  - 35 - 40 m/s
  - 40 - 45 m/s
  - 45 - 50 m/s
  - 50 - 55 m/s
  - 55 - 60 m/s
  - 60 - 65 m/s
  - 65 - 70 m/s
  - 70 - 75 m/s
  - > 75 m/s

Map showing wind speeds in different regions.
WIND HAZARD MODEL
DAMAGE TO THATCHED HOUSES WITH MUD WALLS
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003
WIND HAZARD MODEL
DAMAGE TO ROAD NETWORK
DUE TO SEVERE CYCLONIC STORM 12-15 DECEMBER 2003

LEGEND
- District Boundary
- Mandal Boundary
- Damage to road network
  No significant damage
  < 5 km
  5 - 10 km
  10 - 20 km
  20 - 30 km
  31 - 50 km
  51 -100 km
  No Data

EAST GODAVARI
WEST GODAVARI
KRISHNA
GUNTUR
Wind Vectors

Maximum Instantaneous Wind Speeds 1990 Cyclone
Inundation - East Godavari
Cycle: 1996110506
Rainfall Data
- from Cyclone Model
- Telemetry Data
- IMD Network
- Satellite Derived (region)

Inflow into River Mouths
- Developed and Calibrated 1:1Mil
- To develop for 1:250000 and 1:50000

Additional Inputs from:
- Measured Telemetry and Discharges
- Gauge Network from CWC, Hydrology Network from I&CAD

MIKE 11
- 3D-DEM
  - Completed 1:50K
  - Process: 1:25 K (Coastal 20Km stretch only)

Hazard Mitigation Modeling System for Floods
- River Channel Survey
- Bank Levels

From cyclone models

GIS Offline Interface
- (Overlaying, Zooming and Other Data Input)

Flood Watch

Decision Support System

Quantification of Flooding
- Flood areas
- Depth/Duration/Extent

Advisories/ Bulletins

VALUE ADDITION
- Damage Quantification
- Advisories for facilitating relief routing
- Increase in Lead time
- Delta Water Management and Water Quality Management
- Flood Control Strategies (long-term and short-term mitigation plans)
Andhra Pradesh flood modelling

- 24 Rivers Modelled, including Godavari, Krishna, and Pennar
- Flood forecasting covering 14 districts
- Network of real-time river and rainfall gauges
- Rain gauges – 55 Nos
- River gauges/Tide Flow – 49 Nos
- Meteorological Stations – 5 Nos
- Real-Time Monitoring of River Flows
UP Model

- Upscaled Physically-based model designed:
  - to simulate water exchanges between the land surface and the atmosphere
  - to simulate lateral transfer of water, solutes and sediment
  - to be applicable from catchment-scale to continental-scale
UP Element

- Precipitation
- Evapotranspiration
- Soil water storage
- Surface runoff
MIKE 11 GIS

- Flood Mapping: MIKE 11-GIS
- Fully integrated GIS based flood modelling
- Centred on ArcView GIS
- Leverages full power of GIS for modelling
- Pre-processing: Floodplain schematization
- Post-processing: Inundation maps, Comparison maps, Duration maps
- Analysis with other GIS data
Basic data requirements for modelling

- River cross-sections
- Maps of floodplains
- Historical river flow data
- Tidal variations
- Data on structures along river that affect flow
River Pennar Model

- Model extends from Somasila to Bay of Bengal
- The total modelled length of the River Penneru is around 117 km
- Major structure is Somasila dam
- One existing CWC station at Nellore is present within model reach
FLOOD WATCH

A Management System for Real-Time Flood Forecasting and Warning

MIKE Flood Watch is a decision support system for real-time flood forecasting combining an advanced time series data base with the MIKE 11 hydrodynamic modeling and real-time forecasting system, MIKE11 FF together with the Geographical Information System (GIS), Arc View GIS.
The Strengths of MIKE Flood Watch

A fast and reliable system for real-time operation
Direct-access time series database
Integration with external databases, e.g. Oracle
Automatic import of telemetric data
Data quality control and data processing facilities
GIS presentation facilities
Automatic forecasting and storage of results
Dissemination of flood maps, flood warnings, bulletins and graphics on the World
GOVERNMENT OF ANDHRA PRADESH - DISASTER MANAGEMENT UNIT
FLOOD & CYCLONE MONITORING CENTRE

Catchments
28 May 1988 at 10:00

Flood Status
- Severe
- Moderate
- Alert level
- No level
- No flooding
- No data

[Map of flood and cyclone monitoring areas]
**Front page of District Level flood inundation report**

*Example*: District Collectors, district government offices

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**Legend**
- **SEVERE**
- **MODERATE**
- **BE ALERT**
- **NOT AFFECTED**

---

**Severely affected Mandals**

<table>
<thead>
<tr>
<th>Mandals</th>
<th>Max Flood Depth</th>
<th>+24 hours</th>
<th>+48 hours</th>
<th>+72 hours</th>
<th>Max Flood Depth and Time</th>
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<td>Thotlavalluru</td>
<td>0 m</td>
<td>0.25 m</td>
<td>1.5 m</td>
<td></td>
<td>1.5 m 25/04/01 12.00pm</td>
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<tr>
<td>Pamidim ukkala</td>
<td>0 m</td>
<td>0.6 m</td>
<td>1.5 m</td>
<td></td>
<td>1.6 m 25/04/01 6.00pm</td>
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<tr>
<td>Ghantasala</td>
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<tr>
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<td>1 m</td>
<td>1.4 m</td>
<td></td>
<td>1.5 m 25/04/01 8.00pm</td>
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**Date & Time of Information**: 23 April 2001 8:00 PM

**Date & Time of Transmission**: 23 April 2001 8:15 PM
Nellore District Flood Inundation Map

River Pennar
River Kandaleru
River Swarnamukhi
DSS Outputs – District Level

GOVERNMENT OF ANDHRA PRADESH - DISASTER MANAGEMENT UNIT
FLOOD & CYCLONE MONITORING CENTRE

KHAMMAM
1989/07/24 at 00:00

Flood Status
- Severe
- Moderate
- Alert level
- No flooding
- No data
GOVERNMENT OF ANDHRA PRADESH - DISASTER MANAGEMENT UNIT  
FLOOD & CYCLONE MONITORING CENTRE  

FLOOD ADVISORY BULLETIN  

DISTRICT REPORT  

KHAMMAM DISTRICT (PAGE 1 OF 3)  

<table>
<thead>
<tr>
<th>Mandal</th>
<th>Current</th>
<th>0-24 HRS</th>
<th>24-48 HRS</th>
<th>48-72 HRS</th>
<th>APPROXIMATE TIME AND DATE OF PEAK</th>
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<tr>
<td>AP136</td>
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<td>DUMMAGUDEM</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>1989/07/25 at 10:00</td>
</tr>
<tr>
<td>AP313</td>
<td>ASWAPURAM</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>1989/07/25 at 10:00</td>
</tr>
<tr>
<td>AP315</td>
<td>CHINTUR</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>1989/07/25 at 15:00</td>
</tr>
<tr>
<td>AP323</td>
<td>PALWANCHA</td>
<td>-</td>
<td>S</td>
<td>S</td>
<td>1989/07/25 at 04:00</td>
</tr>
<tr>
<td>AP337</td>
<td>KOTHAGUDEM</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AP343</td>
<td>YELLANDU</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AP344</td>
<td>BHADRACHALAM</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>1989/07/25 at 04:00</td>
</tr>
<tr>
<td>AP348</td>
<td>BAYYARAM</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AP353</td>
<td>TEKULAPALLE</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AP355</td>
<td>BURGAMAPADU</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>1989/07/25 at 04:00</td>
</tr>
</tbody>
</table>

NOTES:  
1. Showing worst situation in time period shown  
2. Blank box indicates no flooding imminent  
3. 'A' indicates alert level reached  
4. 'M' indicates moderate flooding expected
## Bulletin Types

<table>
<thead>
<tr>
<th>Bulletin No.</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Routine Daily State-wide Report based on both Districts and Catchments/Areas</td>
</tr>
<tr>
<td>2</td>
<td>Specific District Report with Mandal forecast information</td>
</tr>
<tr>
<td>3</td>
<td>District Report with indicative Mandal inundation data</td>
</tr>
<tr>
<td>4</td>
<td>District Report with indicative Mandal ‘assets at risk’ assessment</td>
</tr>
<tr>
<td>5</td>
<td>Catchment/Area based Flood Forecasting Station Report</td>
</tr>
</tbody>
</table>
Kandaleru Extreme Flood Event - Nellore District

The map illustrates the flood event in the Kandaleru area of Nellore District, highlighting the inundation zones with different colors indicating the extent of the flood. The map also shows various road networks, including state highways, district roads, and national highways.
HMIS

Hazard Mitigation Information System is a network connecting all the district and Mandal Head quarters with Secretariat and other Heads of Departments through APSWAN for faster and efficient dissemination of information throughout the Andhra Pradesh
Dissemination of Model Outputs

The outputs of all the models analysed through DSS with the help of GIS database are linked to HMIS for faster dissemination to the concerned authorities.
Asia: Issues for TC impact on Agriculture

• Data collection and storage from the region
• Early Warning System for Agriculture?
• Multi-sectoral, multi-country, multi-institutions participation
• Vulnerability and disaster mapping
• Insurance
Regional Groupings / Fora

• SAARC
• AASIAN
• BIMSTEC
• WMO/ESCAP Panel
BIMSTEC

Bay of Bengal Initiatives for Multi-Sectoral Technical and Economic Cooperation
Medium Range Prediction and Drought Monitoring in India
Agromet Advisory Service (AAS) in India
Agromet Advisory Service (AAS) Network

Total Units: 107
Salient Features of Agromet Advisory Service (AAS)

- At present in 107, but plans to cover all 127 agro-climatic zones.

- Units are opened in State Agricultural Universities and ICAR Institutes.

- NCMRWF issues location specific quantitative weather forecasts upto one week in advance twice a week.

- AAS Units translate these forecasts into Agro-advisories and disseminate them to Media and also directly to farmers.

- Units run Crop Weather Models and include output in the Day today advisories.
NCMRWF FORECAST PRODUCTS
DISSEMINATED TO AAS UNITS

◆ 24 HR PRECIPITATION (MM)
◆ AVERAGE CLOUDINESS (OKTA)
◆ AVERAGE WIND SPEED (KMPH) AT 10 FT HEIGHT
◆ PREDOMINANT WIND DIRECTION (DEG.) AT 10 FT HEIGHT
◆ MAXIMUM TEMPERATURE TREND (DEG. C) AT 4.5 FT HEIGHT
◆ MINIMUM TEMPERATURE TREND (DEG. C) AT 4.5 FT HEIGHT

Frequency of Forecast: Twice-a-week
Dissemination: On Tuesday and Friday
Period covered: 4 days
AGROMETEOROLOGICAL ADVISORY SERVICE OF NCMRWF

NCMRWF
PREPARATION OF LOCATION SPECIFIC FORECAST

VSAT FAX PHONE

AAS UNITS (SAUs / ICAR institutes)
PREPARATION OF AGROMET ADVISORY BULLETIN

FEEDBACK FROM FARMERS/ AAS UNIT

FARMERS’ FEEDBACK

AIR T.V. PRINT

PERSONAL CONTACT

FARMERS
FORMAT FOR AGROMET ADVISORY BULLETIN

- **WEATHER INFORMATION**
  - Weather summary of preceding week,
  - Climatic normal for the week,
  - Weather forecast and
  - Crop moisture index, Drought severity index etc.

- **CROP INFORMATION**
  - Type, state and phenological stages of the crops
  - Information on pest and disease and
  - Information on crop stresses

- **ADVISORY BULLETIN**
  - Crop-wise farm management information tailored to weather sensitive agricultural practices like sowing, irrigation scheduling, p & d control operation, fertilizer use etc.
  - Spraying condition for insect, weed and their products
  - Wildfire rating forecasts in wildfire prone areas
  - Livestock management information for housing, health and nutrition etc.
Weather Events covered in AAS

- Frost / Cold Wave
- Heat Wave
- Heavy Rain / Snowfall
- Dry Spell
- Strong Winds
- Hail
- Cyclone
## Crops/ Livestock covered under AAS

<table>
<thead>
<tr>
<th>Field crops</th>
<th>Vegetables</th>
<th>Horticultural</th>
<th>Livestock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Tomato</td>
<td>Apple</td>
<td>Avian Birds</td>
</tr>
<tr>
<td>Wheat</td>
<td>Cauliflower</td>
<td>Mango</td>
<td>Sheep/ Goat (wool, meat)</td>
</tr>
<tr>
<td>Sorghum</td>
<td>Potato</td>
<td>Grapes</td>
<td>Cow / Buffalow (milk)</td>
</tr>
<tr>
<td>Millet</td>
<td>Toria</td>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>Onion</td>
<td>Coconut</td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>Beans</td>
<td>Guava</td>
<td></td>
</tr>
<tr>
<td>Gram</td>
<td>Ginger</td>
<td>Papaya</td>
<td></td>
</tr>
<tr>
<td>Soybean</td>
<td>Peas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundnut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sesam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cowpea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Major Agricultural Operations covered under AAS

- Sowing / Transplanting
  - Rainfed
  - Irrigated
- Pest & Disease
  - Spraying
- Water Management
  - Irrigation
- Fertiliser Application
- Harvesting
- Post Harvesting / Storage
# ECONOMIC IMPACT ASSESSMENT OF AAS

Based on Farmer's feedback, Field visits by scientists, Objective techniques (Crop cutting and Saving due to reduction in farm inputs) and Notional savings

<table>
<thead>
<tr>
<th>FIELD UNIT</th>
<th>Crops/ Livestock</th>
<th>Weather Events/ Management Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kovilpatti</td>
<td>Sorghum, Cotton</td>
<td>Early sowing</td>
</tr>
<tr>
<td>Ludhiana</td>
<td>Potato, Tomato</td>
<td>Frost</td>
</tr>
<tr>
<td>Coimbatore</td>
<td>Sorghum, Maize, Banana, Onion</td>
<td>Early sowing, Wind speed, Cloudiness</td>
</tr>
<tr>
<td>Madras</td>
<td>Poultry</td>
<td>Thermal stress, Pest &amp; Disease management</td>
</tr>
<tr>
<td>Namakkal</td>
<td>Poultry</td>
<td>Heat stroke, Disease management</td>
</tr>
<tr>
<td>Pune</td>
<td>Sorghum</td>
<td>Dry sowing</td>
</tr>
<tr>
<td>Raipur</td>
<td>Chilli, Potato</td>
<td>Irrigation, Wind speed, Cloudiness</td>
</tr>
<tr>
<td>Anand</td>
<td>Pigeonpea, Cotton, Potato</td>
<td>Pesticide application</td>
</tr>
</tbody>
</table>

SAVINGS ACHIEVED: 2-20%
Medium Range Forecast and Drought Monitoring during MONSOON-2005
Onset and Advance of Monsoon

- Late onset over Kerala by about 4 days (5th June)
- Delayed advance over northeast India by about two weeks (16th June)
- Monsoon arrived over Mumbai late by 9 days (19th June)
Onset and Advance of Monsoon

- Onset over central India Delayed by about 10-15 days (20\textsuperscript{th} - 24\textsuperscript{th} June)
- Delayed onset over northern plains by about 7 to 10 days
- Normal Onset over parts of Northwest India including Delhi
- Monsoon covered entire country by 30\textsuperscript{th} June, 15 days ahead of normal date.
Progress of Monsoon over different parts of the Country
Monsoon-2005: A Glimpse

Country as a whole rainfall Distribution:
Normal for 1 June-28 September = 884.4 mm
Actual rainfall = 872.8 mm
% Dep. From Normal = -1%

Zone-wise rainfall distribution

<table>
<thead>
<tr>
<th>Zone</th>
<th>Normal</th>
<th>Actual</th>
<th>% Dep</th>
</tr>
</thead>
<tbody>
<tr>
<td>North-west</td>
<td>608.7</td>
<td>550.0</td>
<td>-10%</td>
</tr>
<tr>
<td>Central</td>
<td>985.6</td>
<td>1092.2</td>
<td>+11%</td>
</tr>
<tr>
<td>South Peninsula</td>
<td>711.2</td>
<td>798.5</td>
<td>+12%</td>
</tr>
<tr>
<td>North-east India</td>
<td>1415.7</td>
<td>1122.9</td>
<td>-21%</td>
</tr>
</tbody>
</table>

Sub-Division wise rainfall distribution

- Excess = 9 (25%)
- Normal = 23 (64%)
- Deficient = 4 (11%)
- Scanty = 0

District wise rainfall distribution

- Excess = 110 (22%)
- Normal = 249 (50%)
- Deficient = 133 (26%)
- Scanty = 11 (2%)
- No Rain = 0 (0%)
Monsoon-2005: Month-wise rainfall performance
Exceptionally Heavy rains in Indian Metros-2005

Mumbai: 26 July
Delhi: 15 September
Visakhapatnam: 16 October
Kolkata: 21 October
Bangalore: 22 October
Chennai: 26 October
<table>
<thead>
<tr>
<th>Week</th>
<th>Week ending</th>
<th>All India % rainfall departure</th>
<th>No of deficient/scanty subdivisions</th>
<th>% Realized Rainfall out of Season's Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Weekly</td>
<td>Cumulative for the period beginning</td>
<td>Weekly cumulative for the period</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>from 1 June</td>
<td>beginning from 1 June</td>
</tr>
<tr>
<td>1</td>
<td>08-6-2005</td>
<td>-54</td>
<td>-51</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>15-6-2005</td>
<td>-67</td>
<td>-59</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>22-6-2005</td>
<td>-31</td>
<td>-49</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>29-6-2005</td>
<td>+32</td>
<td>-20</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>06-7-2005</td>
<td>+34</td>
<td>-2</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>13-7-2005</td>
<td>+3</td>
<td>+1</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>20-7-2005</td>
<td>-6</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>8</td>
<td>27-7-2005</td>
<td>+1</td>
<td>+2</td>
<td>18</td>
</tr>
<tr>
<td>9</td>
<td>03-8-2005</td>
<td>+16</td>
<td>+5</td>
<td>16</td>
</tr>
<tr>
<td>10</td>
<td>10-8-2005</td>
<td>-25</td>
<td>+2</td>
<td>20</td>
</tr>
<tr>
<td>11</td>
<td>17-8-2005</td>
<td>-46</td>
<td>-2</td>
<td>28</td>
</tr>
<tr>
<td>12</td>
<td>24-8-2005</td>
<td>-17</td>
<td>-3</td>
<td>22</td>
</tr>
<tr>
<td>13</td>
<td>31-8-2005</td>
<td>-51</td>
<td>-6</td>
<td>27</td>
</tr>
<tr>
<td>14</td>
<td>07-9-2005</td>
<td>-27</td>
<td>-8</td>
<td>20</td>
</tr>
<tr>
<td>15</td>
<td>14-9-2005</td>
<td>+34</td>
<td>-5</td>
<td>9</td>
</tr>
<tr>
<td>16</td>
<td>21-9-2005</td>
<td>+61</td>
<td>-2</td>
<td>11</td>
</tr>
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<td>17</td>
<td>28-9-2005</td>
<td>-1</td>
<td>-1</td>
<td>20</td>
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</tbody>
</table>
Chattisgarh

East UP

1-22 June

Orissa
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Met Sub-divisions</th>
<th>%Cumulative Rainfall Dep. From normal as on 24 Aug., 2005</th>
<th>%Cumulative Rainfall Dep. From normal as on 31 Aug., 2005</th>
<th>Change of Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>West U.P.</td>
<td>-20% (D)</td>
<td>-26% (D)</td>
<td>D</td>
</tr>
<tr>
<td>2</td>
<td>West Rajasthan</td>
<td>-28% (D)</td>
<td>-34% (D)</td>
<td>D</td>
</tr>
<tr>
<td>3</td>
<td>East Rajasthan</td>
<td>-10% (N)</td>
<td>-17% (N)</td>
<td>D</td>
</tr>
<tr>
<td>4</td>
<td>Haryana, Chandigarh and Delhi</td>
<td>-12% (N)</td>
<td>-18% (N)</td>
<td>D</td>
</tr>
<tr>
<td>5</td>
<td>West Madhya Pradesh</td>
<td>-12% (N)</td>
<td>-19% (N)</td>
<td>D</td>
</tr>
<tr>
<td>6</td>
<td>East Madhya Pradesh</td>
<td>+32% (E)</td>
<td>+22% (E)</td>
<td>D</td>
</tr>
<tr>
<td>7</td>
<td>Gujarat</td>
<td>+42% (E)</td>
<td>+33% (E)</td>
<td>D</td>
</tr>
<tr>
<td>8</td>
<td>Orissa</td>
<td>-5% (N)</td>
<td>-10% (N)</td>
<td>D</td>
</tr>
<tr>
<td>9</td>
<td>Chattisgarh</td>
<td>-11% (N)</td>
<td>-17% (N)</td>
<td>D</td>
</tr>
<tr>
<td>10</td>
<td>Telangana</td>
<td>+14% (N)</td>
<td>+9% (N)</td>
<td>D</td>
</tr>
<tr>
<td>11</td>
<td>Marathwada</td>
<td>+12% (N)</td>
<td>+6% (N)</td>
<td>D</td>
</tr>
<tr>
<td>12</td>
<td>Vidarbha</td>
<td>+7% (N)</td>
<td>0% (N)</td>
<td>D</td>
</tr>
<tr>
<td>13</td>
<td>Bihar</td>
<td>-20% (D)</td>
<td>-11% (N)</td>
<td>I</td>
</tr>
<tr>
<td>14</td>
<td>Rayalaseema</td>
<td>+16% (N)</td>
<td>+26% (E)</td>
<td>I</td>
</tr>
<tr>
<td>15</td>
<td>South Interior Karnataka</td>
<td>+27% (E)</td>
<td>+34% (E)</td>
<td>I</td>
</tr>
<tr>
<td>16</td>
<td>Tamilnadu &amp; Pondicherry</td>
<td>-30% (D)</td>
<td>-11% (N)</td>
<td>I</td>
</tr>
<tr>
<td>S.No.</td>
<td>Sub-Divisions</td>
<td>R/F % Dep. for the period 1 June-14 September</td>
<td>Assessment of situation till end of next week based on current weather situation and medium range prediction of rains for next week</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Assam &amp; Meghalaya</td>
<td>-24%</td>
<td>Subdued rainfall activity is expected during next week. <strong>Not much improvement likely</strong></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Nagaland, Manipur, Mizoram &amp; Tripura</td>
<td>-29%</td>
<td>Some rainfall activity is expected during next week. <strong>Marginal improvement likely</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Jharkhand</td>
<td>-33%</td>
<td>Scattered rainfall activity is likely during the week. <strong>Marginal improvement likely</strong></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Bihar</td>
<td>-20%</td>
<td>Scattered rainfall activity is likely during the week. <strong>Marginal improvement likely</strong></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>East Uttar Pradesh</td>
<td>-22%</td>
<td>Currently experiencing scattered to fairly widespread rains and the same conditions are likely to prevail. <strong>Some improvement likely</strong></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>West Uttar Pradesh</td>
<td>-29%</td>
<td>Currently experiencing fairly widespread with isolated heavy rains and the same conditions are likely to prevail. <strong>Good improvement likely</strong></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>West Rajasthan</td>
<td>-27%</td>
<td>Isolated to Scattered rainfall activity is expected during the week. <strong>Some improvement likely</strong></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>East Rajasthan</td>
<td>-21%</td>
<td>Scattered to fairly widespread rainfall activity is expected during the week. <strong>Good improvement likely</strong></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>West Madhya Pradesh</td>
<td>-21%</td>
<td>Scattered to fairly widespread rains are expected during the week. <strong>Good Improvement likely</strong></td>
<td></td>
</tr>
</tbody>
</table>
Future Plans:
Proposed District
Level Forecast and AAS
Proposed District-level Agro-advisory System of NCMRWF

NCMRWF

Agro-climate level agro-met data

PREPARATION OF DISTRICT-WISE MEDIUM RANGE WEATHER FORECAST

107 AAS UNITS

PREPARATION OF AGRO-CLIMATIC ZONE LEVEL AGRO-ADVISES

District-wise Agro-met data

DISTRICT AGRICULTURE OFFICES OF STATE GOVERNMENTS

Feedback analysis

FARMERS (THROUGH MEDIA, EXTENSION SERVICES, PERSONAL CONTACT)

PREPARATION OF DISTRICT LEVEL AGRO-ADVISES
Proposed District-Level Medium Range Forecast

602 Stations
Pilot Initiative for Village Information System

A new programme launched by DST in collaboration with AP Govt.
Pilot Initiative for Village Information System
(Jointly with NRDMS, SOI, APSRAC, APCOST)

1. Study Area: 10 Villages of Nellore Districts of AP for Cyclone & flood vulnerability assessment 10 Villages of Cuddapa District of AP for drought vulnerability assessment

2. Information to be bundled in addition to existing resources and other data at Village level-
   a. Risk & vulnerability assessment
   b. Mapping of Village scale risk & vulnerability
   c. Details of best practices in respect of effective community level response to the disaster scenario
   d. Risk Mapping of infrastructure, houses, crops, & other common facilities
   e. Mitigation Plans to reduce risk & vulnerability for evolving suitable developmental plans

3. Computing & Network infrastructure establishment
A Typical Layout of REVENUE VILLAGES
Topographic Layers

- Habitation
- Revenue Village
- Settlements
- Roads
- Rail Network
- Canal
- Drainage Lines
- Water Bodies
- Wells
- Forest
- Contour
- Elevation
- Symbol
Thematic Layers from Satellite Images

- Hydrogeomorphology
- Slope
- Soil
- Land Use / Land Cover
- Land and Water Resources Development Plans
Non-Spatial Data for every Habitation

- Census
- Land Information
- Infrastructure
Census

- No. of Households
- Population
- Male/Female
- Age
- Caste
- Literacy
- Work Force
Land Use

- Total Geographical Area
- Forest Area
- Barren and Unculturable Waste Land
- Land put to Non-Agricultural Uses
- Culturable Waste Land
- Permanent Pastures / Grazing Lands
- Land put to Miscellaneous use (Trees/ Groves)
- Fallow land
- Net Area Sown
- Irrigated Land
  (Canals, Tanks, Tube wells, Wells, Check dams, L.I. Schemes)
Infrastructure

- Schools
- Colleges
- Hostels
- Health Institutions
- Veterinary Institutions
- Electricity
- Police Station
- Post Office
- Telephone
- Fire Station
- Banks
- Drinking Water Sources
- Irrigation Sources
- Industries
- Public Distribution System
Infrastructure

- Bus Services
- Women & Child Development Centres
- Non-formal Education Centres
- Village Library
- Rail Services
- Market Yards
- Cooperative Institutions
- Self Help Groups
- Rural Connectivity
- Cable T.V.
- Burial Ground
- Garbage Yard
- Community Latrines
Classification of mandals based on average annual rainfall (mm)
Coefficient of variation of rainfall
Feed & fodder availability status

Critical
Safe
Ground Water Status of Different Mandals of A.P.
Thanks for your kind attention!